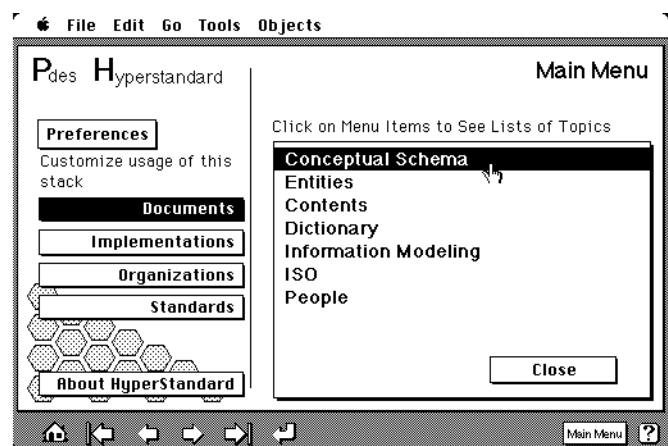NISTIR 88-3859

The Hyperstandard: Applying Hypertext Technology to Standards Development, Dissemination and Implementation

Sanford Ressler

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  🍎  File  Edit  Go  Tools  Objects

  Pdes  Hyperstandard                          Main Menu

  ┌─────────────┐         Click on Menu Items to See Lists of Topics
  │ Preferences │
  └─────────────┘         Conceptual Schema
  Customize usage of this  Entities
  stack                    Contents
  ┌──────────────────┐     Dictionary
  │      Documents   │     Information Modeling
  ├──────────────────┤     ISO
  │  Implementations │     People
  ├──────────────────┤
  │   Organizations  │
  ├──────────────────┤
  │     Standards    │                              ┌───────┐
  └──────────────────┘                              │ Close │
  ┌──────────────────┐                              └───────┘
  │ About HyperStandard│

  ⌂  ⇤  ⇦  ⇨  ⇥  ⏎                    Main Menu  ?
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The Hyperstandard:
Applying Hypertext Technology
to Standards Development, Dissemination
and Implementation

by
Sanford Ressler
National Institute of Standards and Technology
September 1988

Introduction

Standards in the domain of information processing and engineering differ in several fundamental ways from those in the physical sciences. Most obviously there is no physical entity that we call THE STANDARD (the Standard Reference Material). In addition information processing standards are entities which are to be "implemented" by some automata. A paper document (the specification) is created and must be distributed containing all necessary and presumably sufficient information required to implement the standard.

Faced with implementing a standard an individual must treat the standards document as the specification against which to compare their interpretation of that document. Typically a terse concise document which seeks to eliminate ambiguity of interpretation, the standard is often little help for the implementor.

A hyperstandard is proposed which uses several existing computing technologies (hypertext[3,16], CD-ROM[14], document processing) combined in a novel way to address a number of problems in the development and implementation of standards. A hyperstandard system is the embodiment of a particular standard, related documents, images, sounds and programs in the context of a particular physically implemented system. The term "Hyper" is derived from hypertext systems. A term coined by Ted Nelson[17]. A hypertext document consists of a collection of "interconnected writings." The standard's implementor or user could browse through the document and upon encountering some point of interest could follow that point and travel along its connections to find other (cross referenced) points in that collection of writings. Rather than limiting these "documents" to pure text we may, given present technology, also incorporate graphics, audio and computer programs into the content of the document creating what is known as a hypermedia document. (The words hypertext and hypermedia are used interchangeably in this paper.) The concept of a hyperstandard system is explored primarily in the context of a particular ongoing standards effort known as PDES[10] (Product Data Exchange Specifica-

tion).

Optical Storage Technology

Much of this concept would be an impractical idea which would require vast resources to implement and deliver were it not for the availability of an inexpensive mass storage medium. That medium is the CD-ROM (Compact Disc Read Only Memory.) CD-ROMs are a random access optical storage medium capable of storing 550 million bytes of information on a 5 1/2" laser readable disk (identical to the CDs used at home for music). That disk may be duplicated in quantity for a cost of $2 to $5. Given this mass storage capacity (equivalent to 300 unabridged copies of the novel *Moby Dick*) one can conceive of providing standards complete with large amounts of supplemental information including available implementations. The CD-ROM drives used to read the data currently function with personal computers, workstations and mainframes, and cost around $1000.

## Standards Development, Dissemination and Implementation

Three very different activities are encompassed in the scope of a hyperstandard system. First is the process of developing the standard. Second is the dissemination of the standard. Third is implementation of the standard after it has been defined. These three activities are very different and should be clearly delineated. Hypertext technology can be applied to all these activities in useful ways.

Standards Development

Developing a standard is often a long and arduous process. Affected as much by "political" consensus as by technical decisions the standards development process is a good example of group work. CSCW[6] (Computer Supported Cooperative Work) is a new domain of research which addresses the area of group work. One other factor which must be noted is an emerging trend in the development of standards from the tradition of codifying existing practices to the development of technology involving research for the creation of a new standard. Breaking new technological ground is all the more difficult because consensus views and expertise will be more difficult to find.

First let's examine the standards development process taking place for PDES. The standard is being developed by the IGES/PDES Voluntary Organization which is open to any interested individuals. The overall organization has been broken into a number of committees. Each committee works on separate portions of the standard and produces working documents about their domains. The problems increase when each of the committees' work must be integrated with the others into a uniform

consistent whole. Overlap in the committees must be reduced with the goal being a standard that is as unambiguous as possible.   The following diagram illustrates a simplified view of the development process.

Definition $\longrightarrow$ **Review** $\longrightarrow$ **Integration**

Figure 1
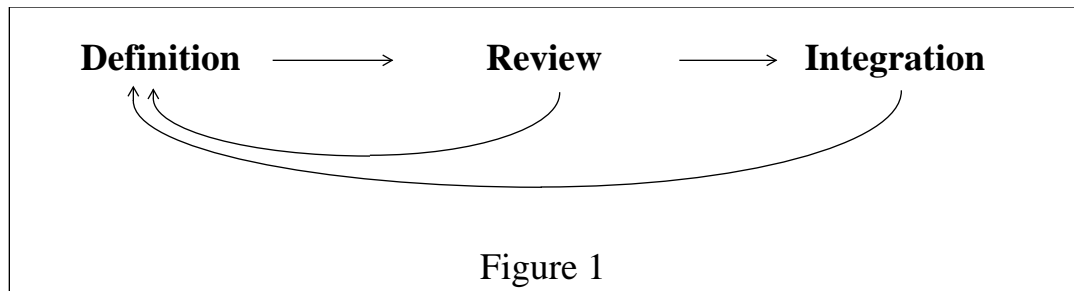
One question which needs to be asked is: Where are there opportunities for the application of systems which can aid in this development process?

Definition is perhaps the lengthiest phase where experts in various domains draw upon their knowledge and experience to identify and create relevant definitions. A mechanism to allow different committees access to documents produced in the definition process and to conveniently look at unresolved issues (see figure 5) would help in communicating the rationale behind the decision making process. Quite often in the course of the development of PDES a great deal of research and thoughtful reasoning which has gone into a decision simply disappears. This information, while not part of the standards document, would be useful, if available as supplementary material.

The reviewing process has been a particularly troublesome area in PDES development. Many working "informal" documents are produced representing individual opinions and positions. Reliable access to the latest versions of drafts are often a problem in voluntary standards development where funding is very limited and resources are stretched to the limit. Determining what documents exist, their status and who "owns" them (see figure 11) would be extremely useful.

Integration is an area which is also quite problematic. The information from the various committees must be tied together into a single coherent document. Ambiguities must be identified and eliminated. When problems occur there must be a systematized mechanism for feedback to the definition phase. Software which aids in identifying duplicate definitions and which produces various cross-references and dictionaries could help. Figure 8 illustrates a display where a user is able to look at the results of the two information modeling methodologies (EXPRESS[11] and IDEF1x[9] as text) being used in PDES to define entities. This information comes from different activities and sources, yet can be placed together and presented to a

user in a coherent manner.

Solutions to the many complex development problems are certainly not presented here, however one can start to think in terms which may lead to a framework for the development of standards that takes advantage of existing hypertext technology. Currently the entire development process is done "by hand." One clear requirement is the automated "computer sensible" form of all documents, including illustrations, source code and prototype implementations when available. This requirement clearly is expensive and difficult to attain with the variety of systems being used.

Standards Dissemination

Disseminating a standard both physically and mentally to the potential users is perhaps the most fruitful domain for applying hypertext. In this case, dissemination is meant to cover both the physical act of distributing the documentation in some form and the process of getting that information into the thoughts of a user community, i.e. education.   Given a CD-ROM based hyperstandard system and a responsible organization for keeping that CD-ROM up to date, a convenient, cost effective and efficient mechanism for distributing the standard can be created.

Some standards documents are very obtuse and difficult to comprehend. Everyone can agree that PDES is very large and complex.   Hypertext can be used to aid the process of learning about the standard. The process of educating potential implementors and the user community is a formidable task. There is no magic, of course. A poorly written standard will remain poorly written when put into a hypertext system. However one can try to reorganize the documents into more accessible and usable information. Placement of the information into an on-line form also allows for information queries and for an intermixing of graphics and text in a number of combinations. In addition, given this method of distribution, one can allow users to add commentary (see figure 9), first stored on the user's local disk and later   incorporated into subsequent releases of the CD-ROM, creating a permanent record.

Standards Implementation

The task of implementing a standard such as PDES is enormous. The implementor must be educated thoroughly enough about the standard to move the specification into an implementation.

Documentation about the kinds of implementations and methodologies for creating implementations would be extremely useful in the context of the specification itself.

A hyperstandard system can also serve the role of software librarian by embedding public domain tools and making them accessible to implementors. In the case of PDES a number of software tools to parse the various types of representations (EXPRESS and IDEF1x) do exist and are a good starting point for implementations. The difficult area of validation and testing can also be aided by packaging some of the testing tools with the specification. Pre-packaged "officially approved and tested" data structures and functions in a variety of languages may also be included as an aid to producing implementations. Rapid, convenient access to the specification will also aid in achieving high quality implementations.

A Test Case

The key to effective use of such large quantities of information is to organize the text, images, audio and source code into a collection of linked documents which may be accessed (searching and browsing) easily by the user. Proof of the validity of this concept will not come by pursuing an abstract standard but rather by taking some existing or developing real standards and developing them into hyperstandards. PDES is the particular standard being explored.

PDES is chosen because it offers a chance to examine an evolving standard which is in great demand by industry. PDES is an extremely large, complex and ambitious standards project which could greatly benefit from this technology. Industry participants are being presented with a daunting array of implementation possibilities and problems. A PDES hyperstandard would gather together not only the official standards documents but related research papers, and public domain software tools which will aid implementors in their tasks.

It must be stated very clearly that the way one might go about creating this collection of "documents" is not at all clear or well defined. No methodology exists to guide one in the creation of such a collection of multi-media information. No standards for hypertext exist, as yet. The best one can do is look at the existing systems in the literature and learn from others. The work done at Brown[19], CMU[1], Xerox[5,7,8], and Tektronix[4] is vital and must be studied carefully.

A Prototype Implementation

A prototype proof of concept implementation of a hyperstandard is being implemented using the HyperCard[2] program. HyperCard is a hypertext environment running on the Macintosh personal computer and allows one to intermix text, graphics and sounds with a flexible user interface. The designer creates buttons which may be clicked on with the mouse to travel from one "card" to another. Collections of cards are known as stacks and one can link from any card to any other card on the

system. HyperCard also has a text importing capability which may be used to automatically create stacks of card and to fill in appropriate information from documents external to HyperCard. This important aspect of the system is discussed later.

The following figures represent a sample of how a user browses through a hyperstandard version of PDES:

This is the main menu card. The items on the left are the top level topics the user may select. Upon selection a list of sub-topics appears and the user may choose any of these. In this example the user has chosen **Conceptual Schema** and goes to the following stack of information.
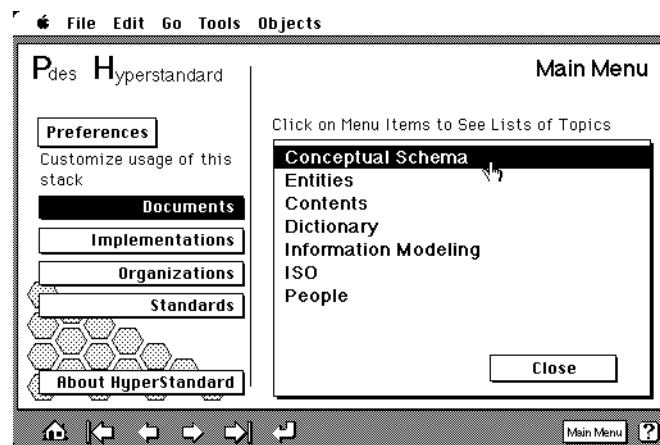
Figure 2

This is a stack representing descriptions of the conceptual schema. The descriptions were entered by hand. The "official" PDES specification descriptions will be parsed into this format at a later date. Each topic has a separate flip card entry and there may be links between the various entries. Clicking on the **Main Menu** button returns the user to the Main Menu card illustrated in figure 2.
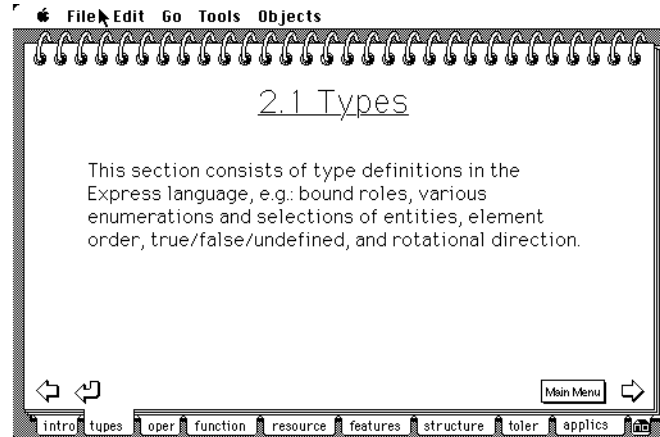
Figure 3

Upon selecting **Contents** from the main menu card the user is taken to the table of contents stack.

This particular stack is significant as the textual information was created automatically from the "official" TeX[13] (a text formatting language) documents which are the PDES draft standard. Clicking on **Geometry** takes the user to a card of subsections.
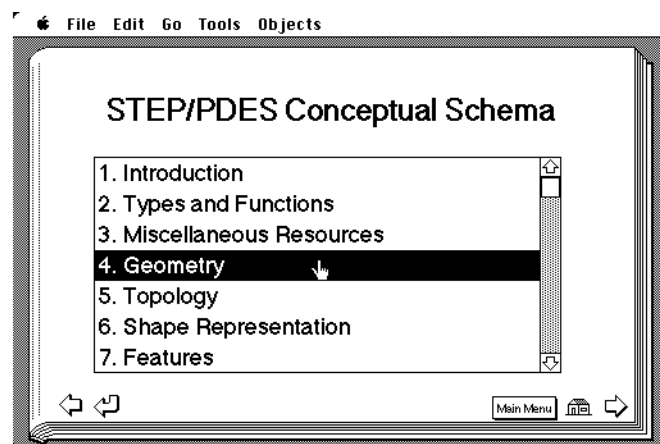

Figure 4

Next the user continues traversing the table of contents and selects the **GEOMETRY** subsection. Again all of this information was entered automatically. Note the **issues** button on the bottom of the screen. This button could take the user to an issues log of unresolved issues concerning the Geometry model.
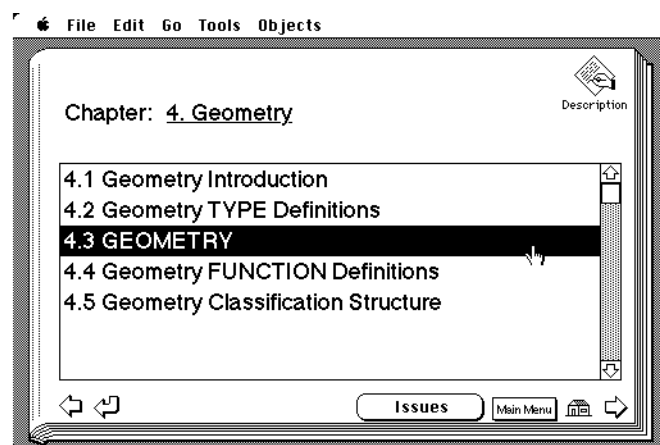
Figure 5

This list of information is a collection of EXPRESS (an information modeling language) entity names. Clicking on an entity will take the user to a new stack of information containing the entity definitions.
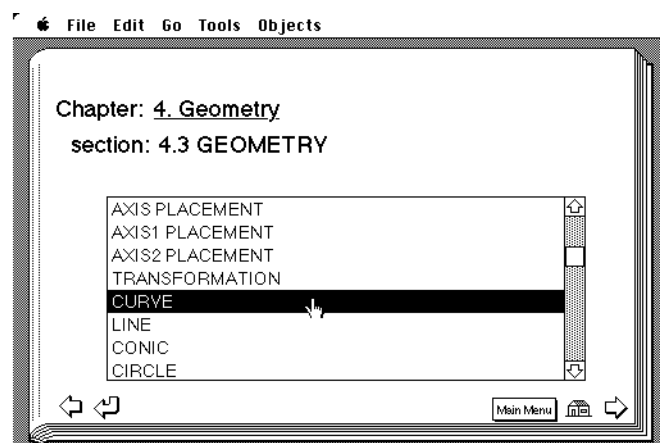

Figure 6

This card contains the entity definition for the previously selected entity. This definition was parsed into the card by a HyperTalk (the programming language of HyperCard) script from information derived automatically from the PDES draft documents. The Contents button in the upper right corner can take the user back to the beginning of the table of contents stack.
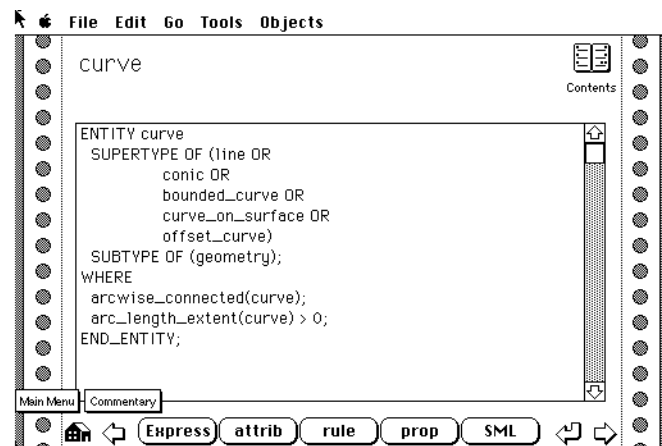
```
 File  Edit  Go  Tools  Objects

curve                                    Contents

ENTITY curve
  SUPERTYPE OF (line OR
         conic OR
         bounded_curve OR
         curve_on_surface OR
         offset_curve)
  SUBTYPE OF (geometry);
WHERE
  arcwise_connected(curve);
  arc_length_extent(curve) > 0;
END_ENTITY;

Main Menu  Commentary

 Express  attrib  rule  prop  SML
```

Figure 7

Upon clicking on the **SML** button the user can see the SML (an ASCII representation of IDEF1x) definition for the entity and can compare it with the EXPRESS definition for consistency. The SML definition was parsed automatically from files used by the PDES Integration committee.
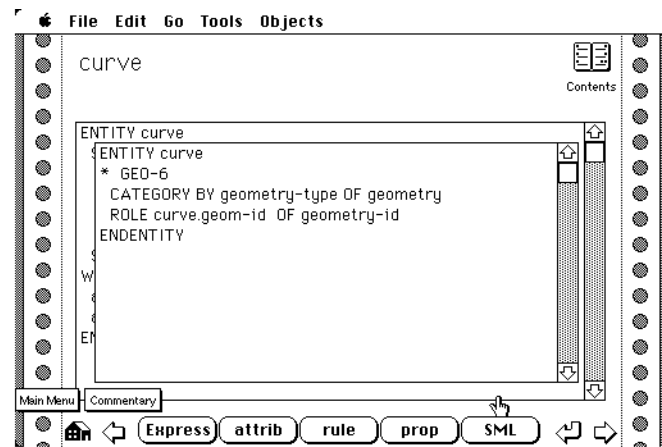
```
 File  Edit  Go  Tools  Objects

curve                                    Contents

ENTITY curve
 ENTITY curve
  * GEO-6
   CATEGORY BY geometry-type OF geometry
   ROLE curve.geom-id OF geometry-id
  ENDENTITY

Main Menu  Commentary

 Express  attrib  rule  prop  SML
```

Figure 8

After clicking the **Commentary** button a user can make a comment about the particular entity being displayed and browse other comments. This creates a log of issues in a relevant context.
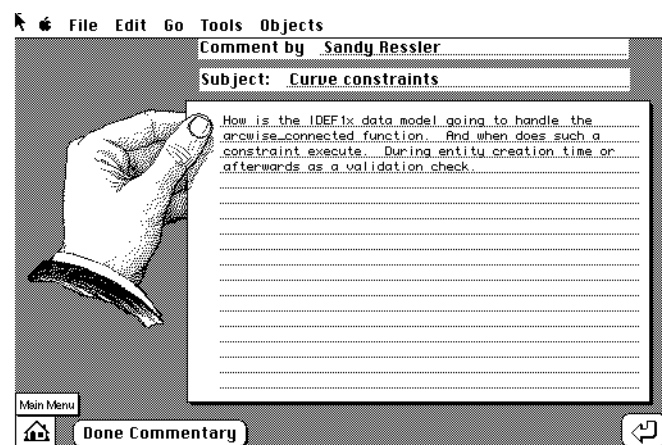
```
 File  Edit  Go  Tools  Objects
Comment by  Sandy Ressler

Subject:  Curve constraints

How is the IDEF1x data model going to handle the
arcwise_connected function.  And when does such a
constraint execute.  During entity creation time or
afterwards as a validation check.

Main Menu

 Done Commentary
```

Figure 9

By clicking on the **User Preferences** button on the Main Menu card the user can customize usage of the Hyperstandard system. For example audio can be controlled and different views of the entities can be chosen.
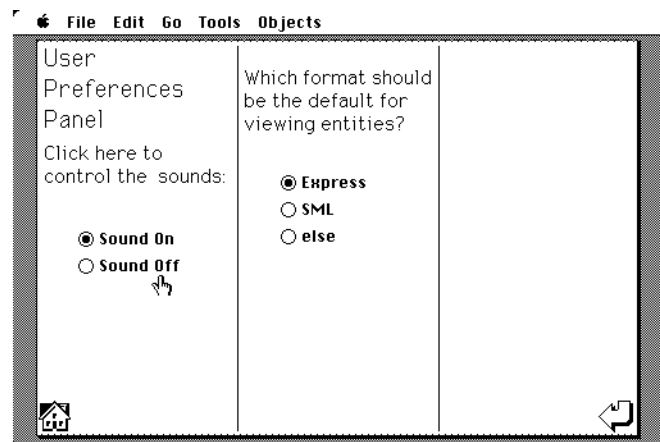

Figure 10

After revisiting the Main Menu card the user can also look at a collection of official ISO document descriptions. This stack of information will aid in determining what particular documents exist and who to contact for the latest copies. The user can also click on the owner's name and be taken to a stack of information containing phone numbers and network
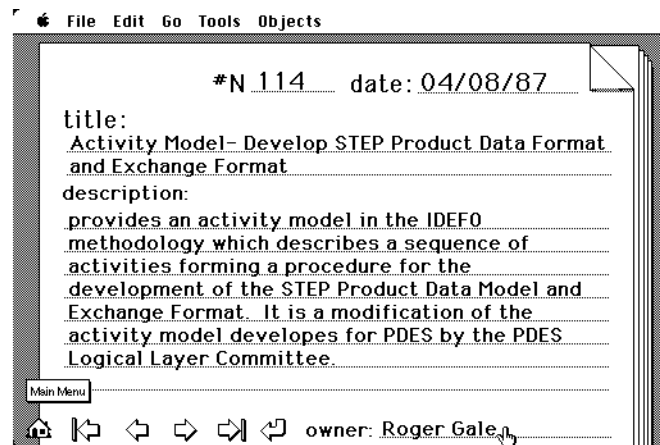
Figure 11

This stack contains a list of all members of the IGES/PDES Voluntary Organization. The names and phone numbers were parsed in from a file, into the cards with this template. The pictures and other information were added by hand but could be done automatically.
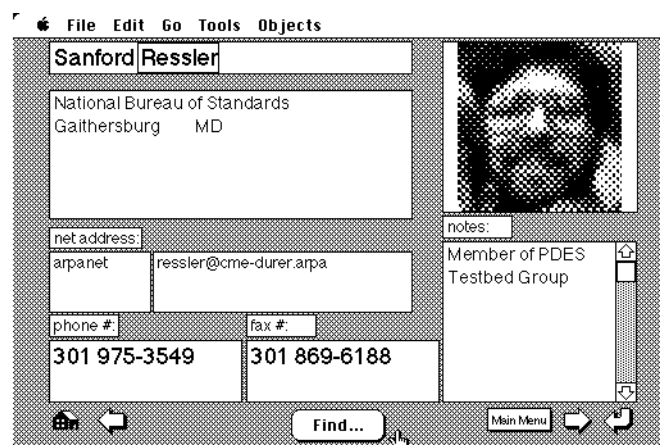

Figure 12

Clicking on the **Information Modeling** topic in the Main Menu will take the user to a library of information about the various information modeling methodologies and techniques being used in PDES. In this example the user has clicked on the IDEF1x "book" and is taken to the following card.
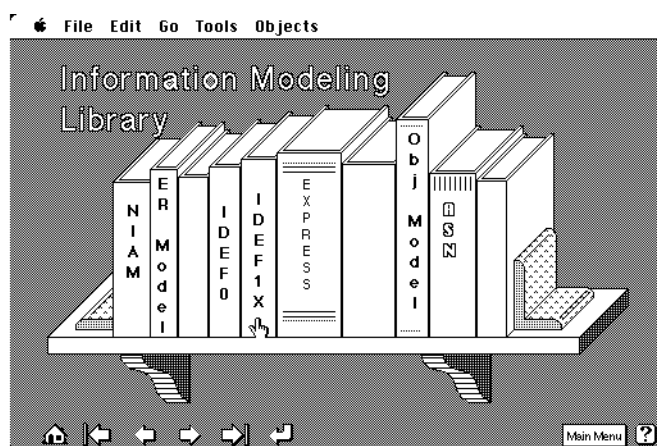

Figure 13

This card illustrates a sample portion of an IDEF1x diagram. An IDEF1x tutorial is planned for this portion of the system.
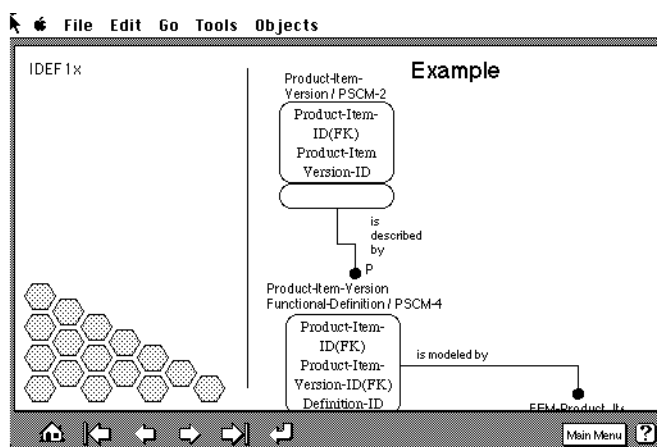

Figure 14

Back on the Main Menu a user can choose to look at the involved organizations. In this example the IGES/PDES Voluntary Organization is chosen.
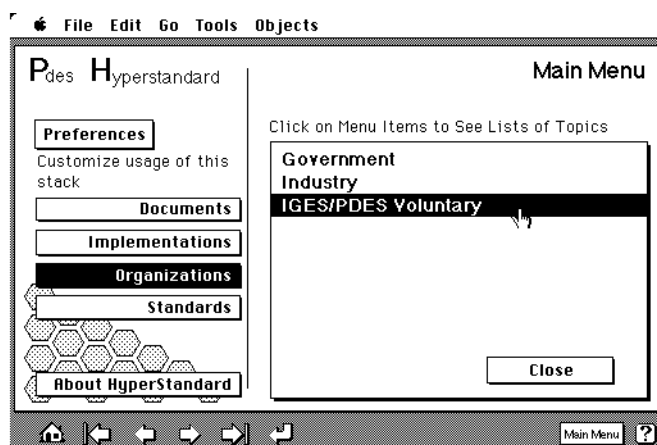

Figure 15

This card is a sub-menu for selecting among a variety of topics specific to the chosen organization. In this case a list of committees that are part of the IGES/PDES organization are presented and can be further traversed.
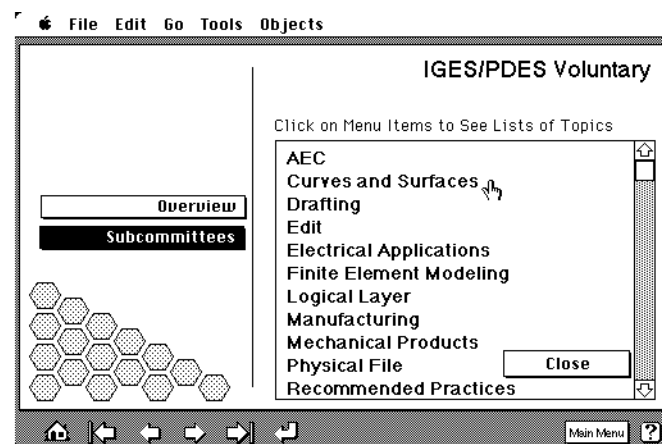

Figure 16

This list of topics on the Main Menu card also presents some of the implementation possibilities being actively discussed for PDES. Clicking on **Knowledge Base** takes the user to the following card.
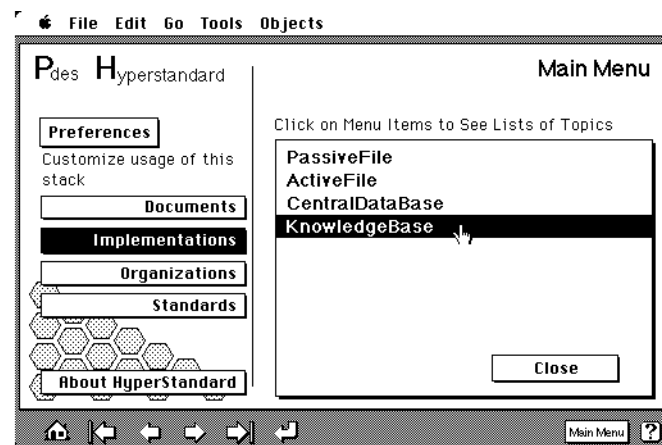

Figure 17

A detailed discussion about knowledge based implementations could be placed here. Note that next to the words object oriented is an asterisk. This indicates that clicking on the word will take the user to a card which will discuss object oriented programming and/or data bases. These links between documents are entered by hand at this time but keyword indexing methods
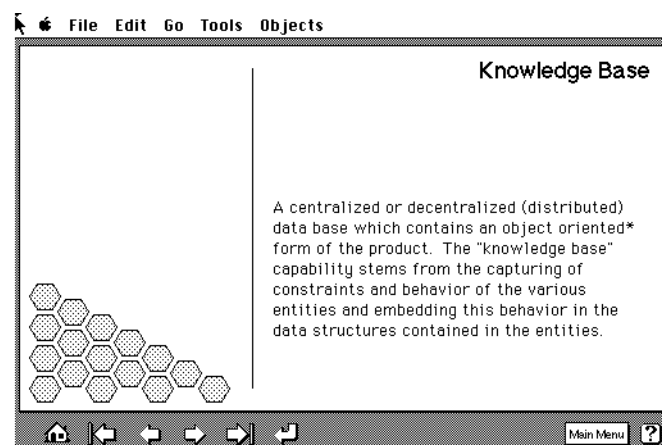

Figure 18

Scaling Up

Now that the concept and a prototype system has been presented, one must ask the question: How do you create a full scale system?

As an example of how one might do this let's again look at PDES. Let's also assume that our target system is going to be a Macintosh with HyperCard. The specification itself exists as TeX (TeX is a text formatting language developed by Donald Knuth) documents, which are ASCII files that may be parsed. One way of getting documents into HyperCard would be to preprocess the documents on a system which has good parsing tools, such as a UNIX based machine with   YACC[12] and Lex[15]. Parsing would generate a set of reformatted documents. A simple Hyper-Card script could be written to format the new documents into a variety of cards.

HyperCard's programming language is called HyperTalk and while it has some interesting features it lacks good tools for parsing. The next problem is formatting the document into meaningful and useful cards. A reasonable approach is to create named template cards by hand on the Macintosh and refer to those names on the UNIX machine. Figure 19 illustrates the overall process.
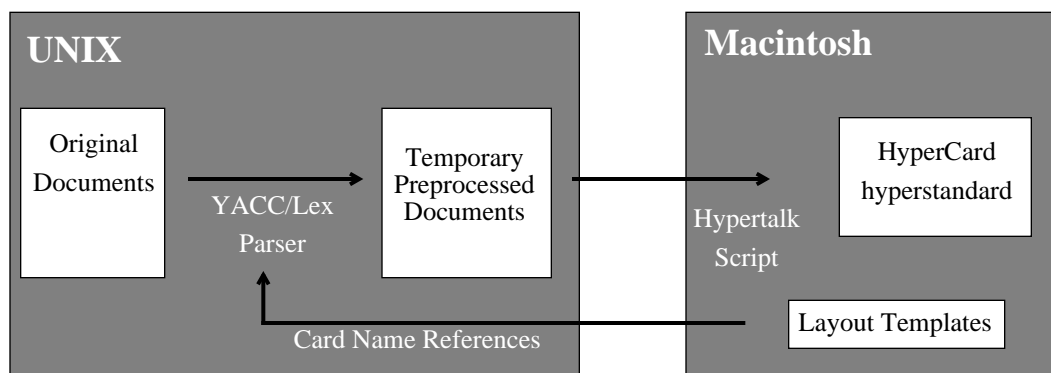

Figure 19

This technique works for the EXPRESS specification document which is a highly structured document. Informal documents and illustrations are still a problem.   The IDEF1x diagrams of PDES can be represented textually by a language called SML. An SML parser could generate a series of drawing commands interpretable by HyperTalk which would automatically create the drawing. However one can only see small portions of the IDEF1x diagrams on a single card. A partial solution to this problem is to display only context diagrams. These diagrams show relationships for only one entity at a time.

Other diagrams and illustrations would be scanned and represented in a computer sensible form. Given a raster type file of an illustration one could get it into HyperCard by creating some simple translation programs. Another approach is to provide a print button which would cause the diagrams to be printed out rather than displayed. The CD-ROM in this case would function as an image library.

Another problem in creating a satisfying hyperstandard system is generating the links. For example, a link between an IDEF diagram of an entity and its definition should be created automatically. This could be accomplished by the preprocessing technique discussed previously and by using consistent naming schemes. An IDEF1x rectangle has text associated with it and that rectangle could be made active by creating a button over it. The link to the EXPRESS definition would be by a reference to the correct HyperCard stack and card.

This entire scheme, while not particularly elegant, would work for most of the PDES standard. In addition, the information obtained directly from the standard and preprocessors could be used to generate useful statistical information, cross references, and indices. Clearly most of the work involved takes place in the preprocessing phase. This has the advantage of providing a platform, at a later time, for moving towards an application independent implementation. Defining the functionality of hypertext/media systems is a ripe domain for standards. SGML[18] (Standard Graphical Markup Language) is an ISO standard which can be used to define the structure of documents. It has great potential for use in mapping documents into a hypertext structure. This would aid in porting a hyperstandard system to a variety of hypertext systems.

Conclusion

A hyperstandard system can provide a medium for the development, dissemination and implementation of information processing standards. Groups of people may coordinate issues and integration activities can be enhanced. An environment for convenient browsing of the standards' specification and related documents can provide a rich source of information. Easy access to the entire domain of a standard can be used to help educate potential users and implementors of the standard. A hyperstandard system can provide implementors with a much richer development environment, complete with research documents and software tools.

A specific prototypical instance of a standard in development (PDES) has been implemented and demonstrated to illustrate the viability of a hyperstandard system.

Acknowledgments

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